Contents

Section 3

Southeast Colorado River Basin

Utah State Water Plan

Introduction

3.1 BACKGROUND

The responsibility for comprehensive water planning was given to the Division of Water Resources by legislative mandate. In accordance with that directive, the Utah State Water Plan[16] was published in 1990 under the direction of the Utah Board and Division of Water Resources and the State Water Plan Coordinating Committee. The Southeast Colorado River Basin Plan is one of eleven prepared as supplements to the State Water Plan. The preparation of this basin plan included valuable input from individuals and from local, state and federal agencies involved with water issues, regulation and development.

The formulation of a comprehensive state water plan is a perpetual and dynamic process. This process requires periodic re-evaluation of the changing issues associated with the development and use of the water resources. As areas grow, there are new demands on the limited water resources. To effectively address the issue of meeting the growing demand for water, basin plans are scheduled for revision every 5 - 15 years.

Spanish Valley

Basin water plans establish and provide a means by which the basic framework of the state's water policy can be implemented at the local water user level. Plan specifics are presented in the remaining sixteen sections of this report covering water supply, use, quality, demand, conservation and development.

> For millions of years, the wind and rain have incessantly formed the winding canyons and sheer cliffs, dissecting the plateaus surrounding the lofty volcanic mountains. Civilizations from aeons of time have inhabited this area to extract a way of life from the fertile soils and the pure water.

3.2 PLANNING GUIDELINES

The mission of the Division of Water Resources is to direct the orderly and timely planning, conservation, development, protection and preservation of Utah's water resources to the end they will be used to meet the beneficial needs of the citizens of the state. Within this context, the State Water Plan[16] and individual basin plans offer comprehensive assessments of both current and projected water conditions.

This overall planning effort provides the basis and background to assess the current and projected status of the state's water resources.

3.2.1 Principles

The Southeast Colorado River Basin Plan is based on a number of principles including:

- All waters, whether surface or subsurface, are held in trust by the state as public property and their use is subject to rights administered by the State Engineer. In addition, the waters of the Navajo Nation are subject to the jurisdiction of the Navajo Nation Water code of 1984.
- Water is essential to life. It is our responsibility to leave adequate water of acceptable quality for future generations.
- The diverse present and future interests of Utah's residents should be protected through a balance of economic, social, aesthetic and ecological values.
- Water uses that are difficult to identify beneficiaries for, such as recreation and aesthetics, should be included in program evaluations.
- Public input is vital to water resources planning.
- All residents of the state are encouraged to exercise water conservation and implement wise use practices.
- Water right owners are entitled to transfer their rights under free market conditions.
- Water resources projects should be technically, economically and environmentally sound.
- Water planning and management activities of local, state and federal agencies should be coordinated.
- Local governments, with state assistance as appropriate, are responsible for providing an acceptable level of protection to the general public against emergency events such as flooding and extended drought.
- Designated water uses and overall water quality should be improved or maintained unless there is evidence the loss in use and quality is outweighed by other benefits.
- The citizens of Utah need a broad-based understanding of water's physical characteristics, potential uses and values to carry out effective planning and management.

3.2.2 Purpose

The purpose of this basin plan is to assist local, state and federal entities in developing appropriate water management and conservation programs, and in coordinating water planning activities. The information presented in this report includes the following goals: identification and discussion of issues impacting the development and use of water resources within the study area; and encouraging all state, federal and local water agencies to actively participate in the overall planning process.

3.2.3 Organization

State water planning is the responsibility of the Division of Water Resources under the auspices of the Board of Water Resources. Other state agencies with major water-related missions have been included in the development of the Southeast Colorado River Basin Plan. Special interest groups and local individuals have also contributed to this plan.

The State Water Plan Coordinating Committee has representatives from twelve state agencies involved to various degrees in the regulation, development and planning of water resources in the state. This committee provides input to the basin planning process from a state-wide perspective.

The State Water Plan Steering Committee consists of the chair and vice-chair of the Board of Water Resources, executive director of the Department of Natural Resources, and the director and assistant director of the Division of Water Resources. The steering committee provides policy guidance, recommendations on prominent water-related issues and final approval to individual basin plans prior to their acceptance by the Board of Water Resources.

Federal and other state agencies, with either direct or indirect involvement in water resources, have participated in the overall preparation of this basin plan. These agencies have particular expertise and perspective on water use and development within this basin.

A Local Basin Planning Advisory Group has provided input to the overall basin planning process by giving advice and making comments on preliminary drafts of this plan. This group was made up of individuals representing various organizations, special interest groups and water users concerned with water development and use issues.

3.2.4 Process

The overall process to prepare a comprehensive water plan for the Southeast Colorado River Basin included completion of the following; the in-house, committee, advisory and public review drafts. The in-house draft provides development of data and review of basic issues and facts relating to local water supply, use and related information about the basin. The committee draft is prepared for review and comments by state agencies involved with local water development and regulation. The advisory draft allows a thorough review of the document by local water users, representatives of various special interest groups, and state and federal agencies concerned with local water issues. The general populace is invited to comment or learn about the contents of the public review draft at meetings held at strategic locations within the basin. Revisions within each draft were necessary to make this document complete and as accurate as possible.

3.3 BASIN DESCRIPTION

The Southeast Colorado River Basin is located in the southeast corner of the state and covers 6,976,250 acres (10,900 square miles), about 12.8 percent of the state. It includes all of San Juan County except Lake Powell and all of Grand County except the area draining north to the Uinta Basin. In addition, the portion of the City of Green River in Grand County is not included. The basin is bordered on the west by the Colorado River and Green River, on the north by the Book Cliffs and on the south and east by the Arizona and Colorado state lines. Although the southern part of the western boundary has been generalized as the Colorado River, the boundary as used in this report is the eastern shoreline of Lake Powell. The Uinta Basin hydrologic area is on the north and the West Colorado River Basin is on the west. The basin boundaries and features are shown on Figure 3-1. Also see Figure 5-1 for hydrologic subarea delineations.

3.3.1 Physiography and Geology[32,62,86]

The basin is located in the Colorado Plateau Province which centers near the four corners area. Elevations vary from about 3,700 feet at Lake Powell's high water level to 11,361 feet on Abajo Peak in the Abajo Mountains and 12,720 feet on Mount Peale in the La Sal Mountains. There are 18 peaks over 10,000 feet in elevation. Monitor Butte is a high point in western Monument Valley at 6,115 feet, over 2,000 feet above the valley floor and Navajo Mountain is 10,387 feet in elevation. The La Sal, Abajo and Navajo mountains are formed by partially eroded lacolith dome intrusions of Tertiary age.

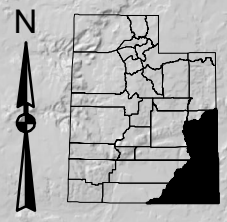
Contrasting geological landscapes

The primary river systems are the Colorado, Dolores, Green and San Juan rivers. Even though the study area ends at the state lines, the

Figure 3-1

LOCATION AND TOPOGRAPHIC MAP

Southeast Colorado River Basin



10 0 10 20 Miles

upper hydrological boundaries for these rivers extend well into Arizona, Colorado, New Mexico and Wyoming. There are other locally important streams throughout the basin, all of them ultimately draining into these four rivers. These streams include Castle Creek, Mill Creek, Pack Creek, Indian Creek, North Creek, South Creek, Recapture Creek, Cottonwood Wash, McElmo Creek and Montezuma Creek (See Figure 5-1).

The area is extremely colorful and features spectacular rock formations, particularly in a number of state and federal parks. As a result of its natural geologic features and its close proximity to Glen Canyon and Lake Powell, the basin is a popular recreational area for both national and international tourists. Lake Powell is one of the most popular recreational sites in the western United States while the Colorado and San Juan rivers attracts many who venture on river rafting trips.

The area is characterized by high mountains and deeply incised canyons. The dissected mesas form several levels, with the highest being 7,000 feet at Monticello. Faulting has interrupted the continuity of the strata in some places. Collapsed salt domes near the La Sal Mountains have formed valleys, such as Lisbon and Spanish valleys, which are bounded by faults.

A characteristic feature of the basin's topography is its horizontal rock structure with steep escarpments which have resulted from gradual erosion over millions of years. Beds up to 1,000 feet thick have eroded away in places leaving isolated blocks standing as mesas.

The processes of canyon erosion and escarpment retreat have resulted in not only spectacular scenery, but unique groundwater conditions. The generalized geology is shown in Figure 3-2. Stratigraphic relations and classifications of bedrock aquifers are shown in Figure 3-3.

3.3.2 Climate[41,73]

The local climate is arid and semi-arid at the lower elevations with a cooler, wetter climate in the La Sal Mountains and Abajo Mountains. Summer temperatures usually reach the high 90s in July to September. The normal maximum temperature ranges from 84° F in Monticello to 99° F in Moab. Winters are dry and cold but usually not severe. The normal minimum temperature ranges from 11° F at La Sal to 18° F at Mexican Hat and Moab. The record high temperature is 114° F at Moab and the record low is -36° F at Cisco.

As a rule, winter snowfall amounts to only a few inches in the lower valleys with an occasional storm producing over one foot. Most of the precipitation is generated from seasonal storm patterns moving in from the Pacific Ocean during the winter and spring months. Summer storms are often localized thunderstorms produced by moist air masses moving in from the Gulf of Mexico.

Storms in red rock country

The average annual precipitation is between 6 and 30 inches depending primarily on elevation. Annual precipitation varies between 8 and 12 inches in most of the area except it is over 25 inches in the Abajo Mountains and it is over 30 inches in the La Sal Mountains. The precipitation in the southwest part of San Juan County, western Grand County and south of the San Juan River is from 6 to 8 inches except on Navajo Mountain where it is over 12 inches. The record daily precipitation is 4.31 inches in Aneth. The record monthly precipitation is 8.28 inches at Cedar Point and the record monthly snowfall is 62 inches at Monticello.

The frost-free days are measured from the last spring day to the first fall day when the

Figure 3-2

GENERALIZED GEOLOGY

Southeast Colorado River Basin

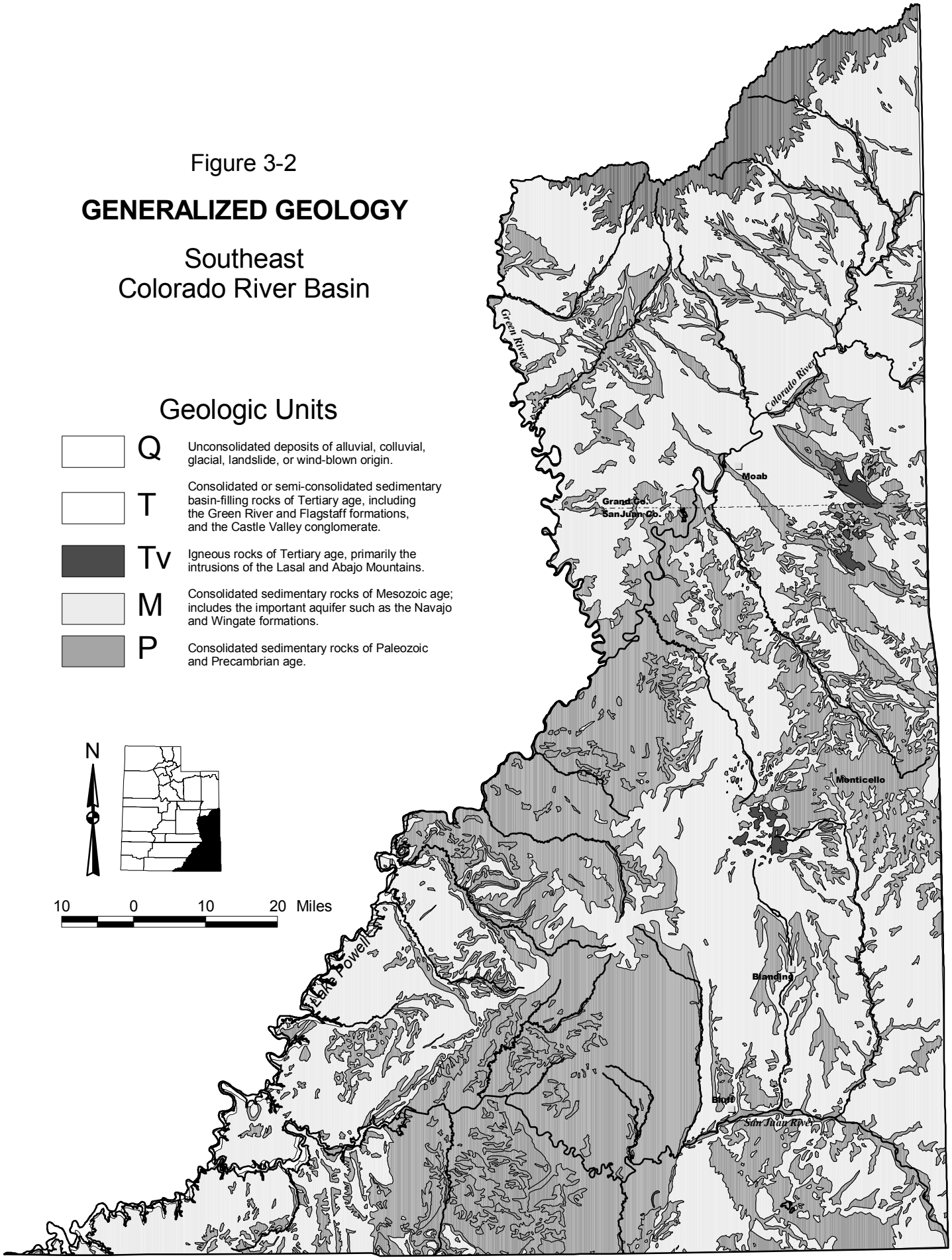
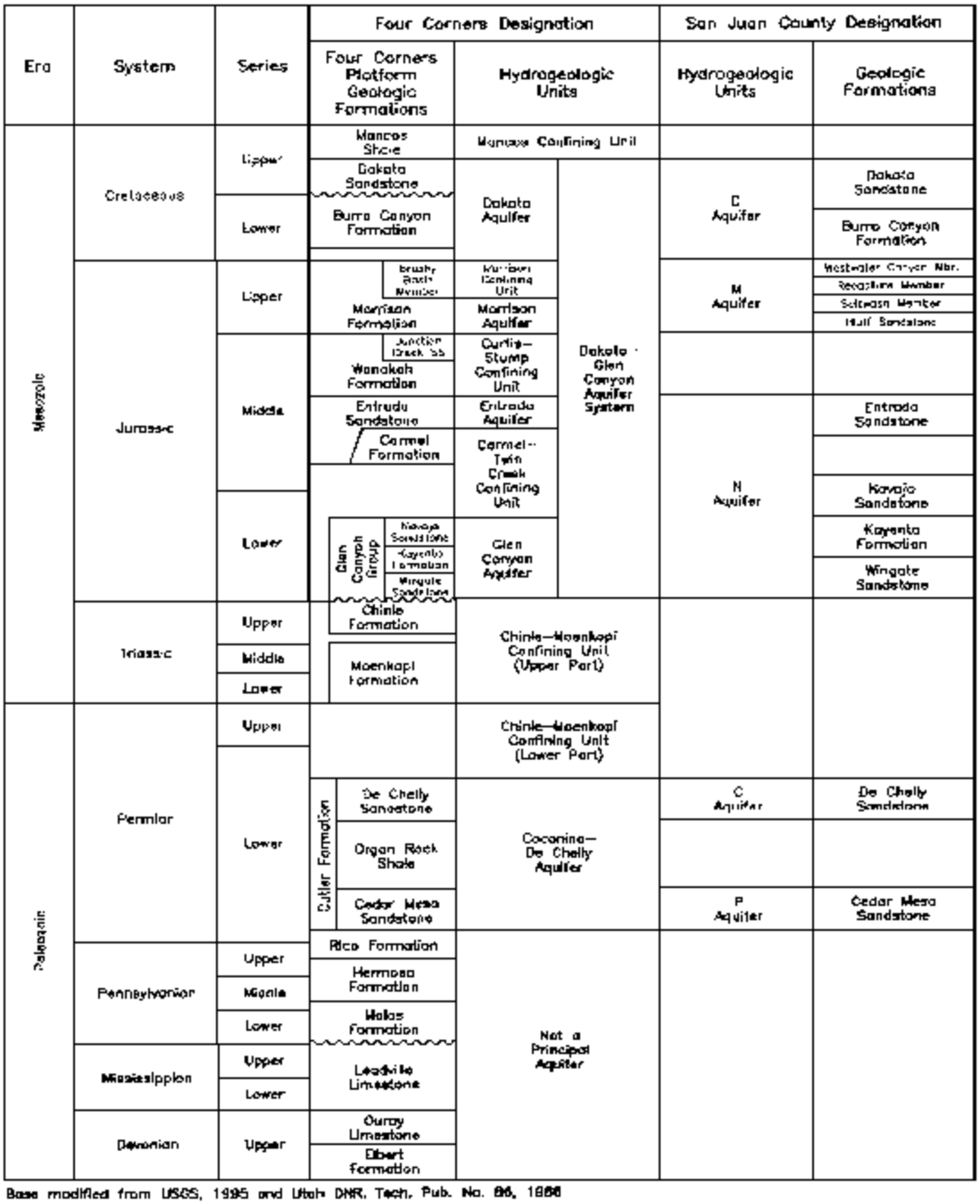


Figure 3-3
GEOLOGIC STRATIGRAPHY



Base modified from USGS, 1995 and Utah DNR, Tech. Pub. No. 86, 1988

Source: San Juan County, Utah Water Master Plan - Wright Water Engineers, Inc.[96]
Note: Hydrologic units are U.S. Geological Survey terminology as designated by Avery. [21]

lowest temperature is 32° F. These vary from 231 at the Hite Marina to 119 days at La Sal.

Temperature, precipitation and frost data are presented in Table 3-1. The locations of climatological reporting stations are shown on Figure 3-4. The average annual precipitation is shown on Figure 3-5 for the 1961-90 base period.

There is one electronic snotel station and one manual snow course located on both the La Sal Mountains and the Abajo Mountains.[73] Normally, the April 1st reading is used to forecast the season water supply. At the two snotel stations, the average March 1st reading is over 0.5 feet higher than the April 1st reading. The snotel and snow course data are shown in Table 3-2 and the locations are shown on Figure 3-4.

3.3.3 Soils, Vegetation and Land Use[69,70,71,72]

Resource data on the soils and vegetation varies in detail, particularly across land ownership and administration boundaries. Land use data varies depending on the purpose for collecting the data and on the methodology used.

Soils and Vegetation - Soil surveys are made to describe the soil profile and the related vegetation. This often describes the land use which is generally dictated by the soil types and the vegetation produced. The Natural Resources Conservation Service has the national responsibility for all soil surveys regardless of land ownership or administration. Under certain conditions, soil surveys are carried out by others such as the Forest Service or Bureau of Land Management. Interagency coordination has made the soil surveys exceptionally useful. The status of the soil surveys is shown on Figure 3-6.

Soil surveys are conducted at different levels of detail. For all but the most intensive surveys, data is collected at three levels; 2nd, 3rd and 4th order mapping described as follows.

The 2nd order surveys are made for intensive land uses. This type survey is conducted on all cropland areas.

The 3rd order surveys are made for land uses not requiring precise knowledge of small areas or detailed soils information. This type survey is conducted on all national forests and the majority of private and public rangelands.

The 4th order surveys are used to provide data for broad land uses, potential planning and general land management.

There are five vegetative types in the basin which occur from the higher elevations above 12,000 feet to Lake Powell at an elevation of 3,700 feet. Vegetation varies from conifer-stands in the high mountains to shadscale and blackbrush in the lower areas. There are also large areas of barren sandstone rock formations and intrusions of partially eroded lacolith domes.

Upland to high mountain vegetation

The **High Mountain Climatic Zone and Conifer-Aspen Forest Type** are at elevations of 8,300 to 13,000 feet with annual precipitation of 25 to 35 inches. Soils are shallow to deep and are found on benches and mountainsides. Erodible soils are susceptible to mass movement. Native vegetation includes Engelman spruce, Douglas fir, subalpine fir, quaking aspen, Gambel oak, mountainmahogany, shrubs, sedges and grasses. This area produces most of the stream flow and all of the commercial timber. Use for

Table 3-1
SELECTED CLIMATOLOGICAL DATA

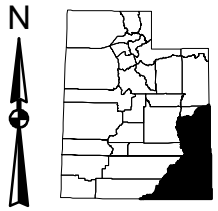
Weather Station	Average Mean Temp	Record Low Temp	Record High Temp	Normal Annual Precip	Record Monthly Precip	Normal Annual Snowfall	Record Month Snowfall	Frost Free Days
		(Degrees F)			(inches)			
Aneth	55.4	-18	110	8.49	5.47	3.3	10.0	183
Blanding	50.0	-23	110	13.05	7.01	44.5	55.0	149
Bluff	53.4	-22	108	8.17	6.35	10.1	21.0	167
Canyonlands-Neck	52.5	-13	104	9.09	5.02	24.5	27.0	168
Canyonlands-Needles	52.8	-16	107	8.53	4.43	16.0	23.3	152
Castle Valley	53.9	-14	107	11.50	3.39	19.9	21.9	187
Cedar Point	46.7	-20	100	14.69	8.28	71.9	48.0	135
Cisco	51.7	-36	108	7.11	2.84	10.9	24.0	154
Dewey	53.3	-25	113	8.62	4.40	13.2	26.0	153
Harley Dome	51.1	-27	106	9.20	3.35	22.4	17.0	156
Hite Marina	60.9	3	112	5.34	5.46	4.6	15.5	231
Hovenweep N.M.	51.3	-24	105	11.52	6.85	22.4	24.2	145
La Sal 2 S.E.	46.2	-25	101	15.03	5.09	50.0	32.0	119
Mexican Hat	56.0	-17	110	6.60	6.20	2.8	13.0	185
Moab	56.8	-24	114	9.00	6.63	6.1	32.0	181
Monticello	45.7	-22	101	15.47	7.64	61.8	62.0	121
Monument Valley-Mission	56.1	-11	106	7.40	5.61	13.4	29.0	200
Natural Bridges N.M.	50.4	-14	103	12.84	8.02	47.9	40.2	147
Navajo Mtn	49.6	-25	100	9.18	5.29	26.3	50.1	142
Thompson	52.8	-23	108	9.19	3.99	12.3	22.5	175

Source: Utah Climate, Utah Climate Center, Utah State University, Logan Utah, 1992.

Figure 3-4

CLIMATOLOGICAL DATA STATIONS

Southeast Colorado River Basin



10 0 10 20 Miles

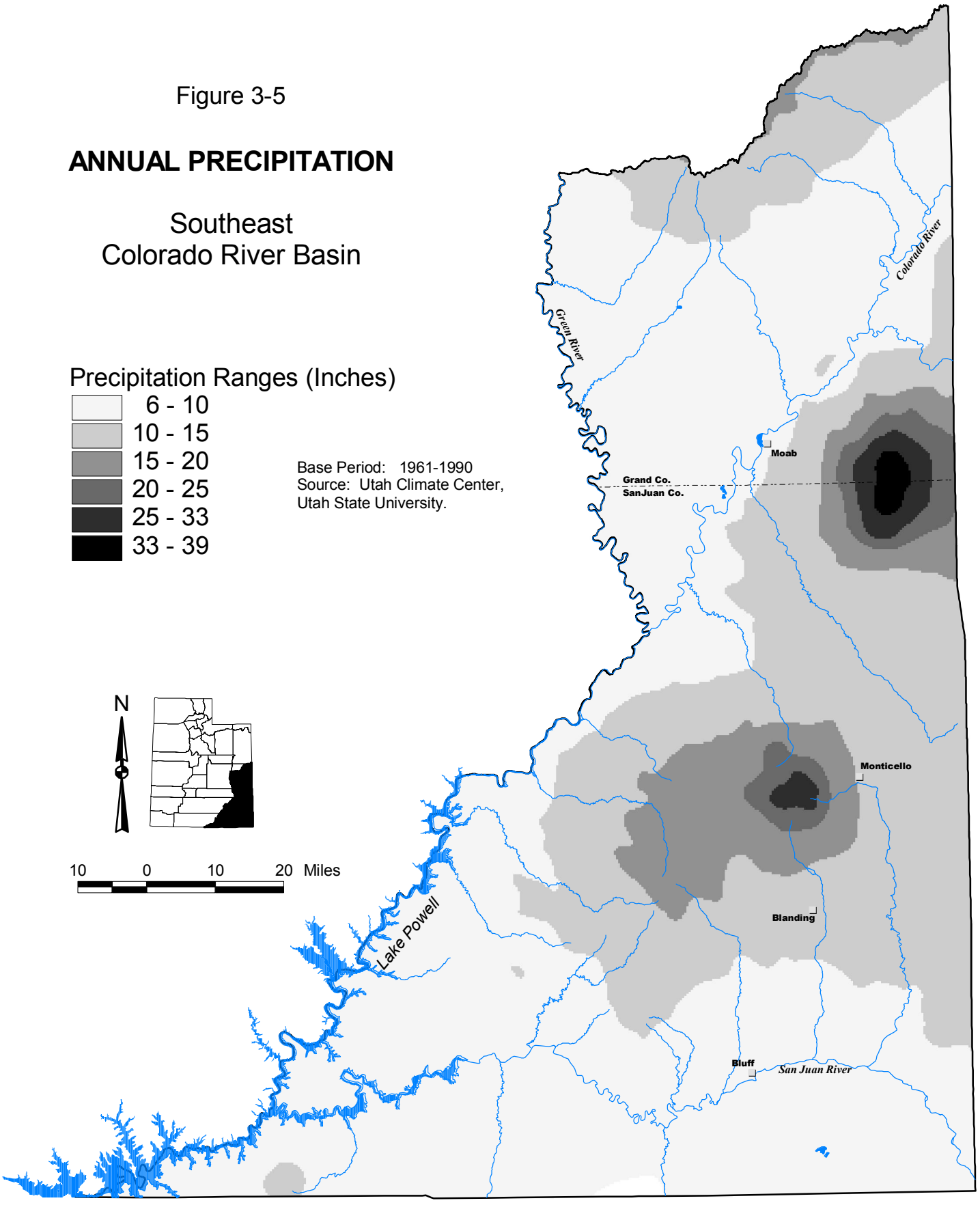
- Climatological Data Stations
- Snow Course Sites
- SNOTEL Sites

Harley Dome
Thompson
Cisco
Dewey
Castle Valley
Moab
Upper La Sal Mountain
Lower La Sal Mountain
Grand Co.
SanJuan Co.
Canyonlands Neck
La Sal
Canyonlands Needles
Buckboard Flat
Monticello
Camp Jackson
Cedar Point
Hite Marina
Natural Bridges
Blanding
Hovenweep
Bluff
Aneth
Mexican Hat
Monument Valley
Navajo Mountain

Figure 3-5

ANNUAL PRECIPITATION

Southeast
Colorado River Basin



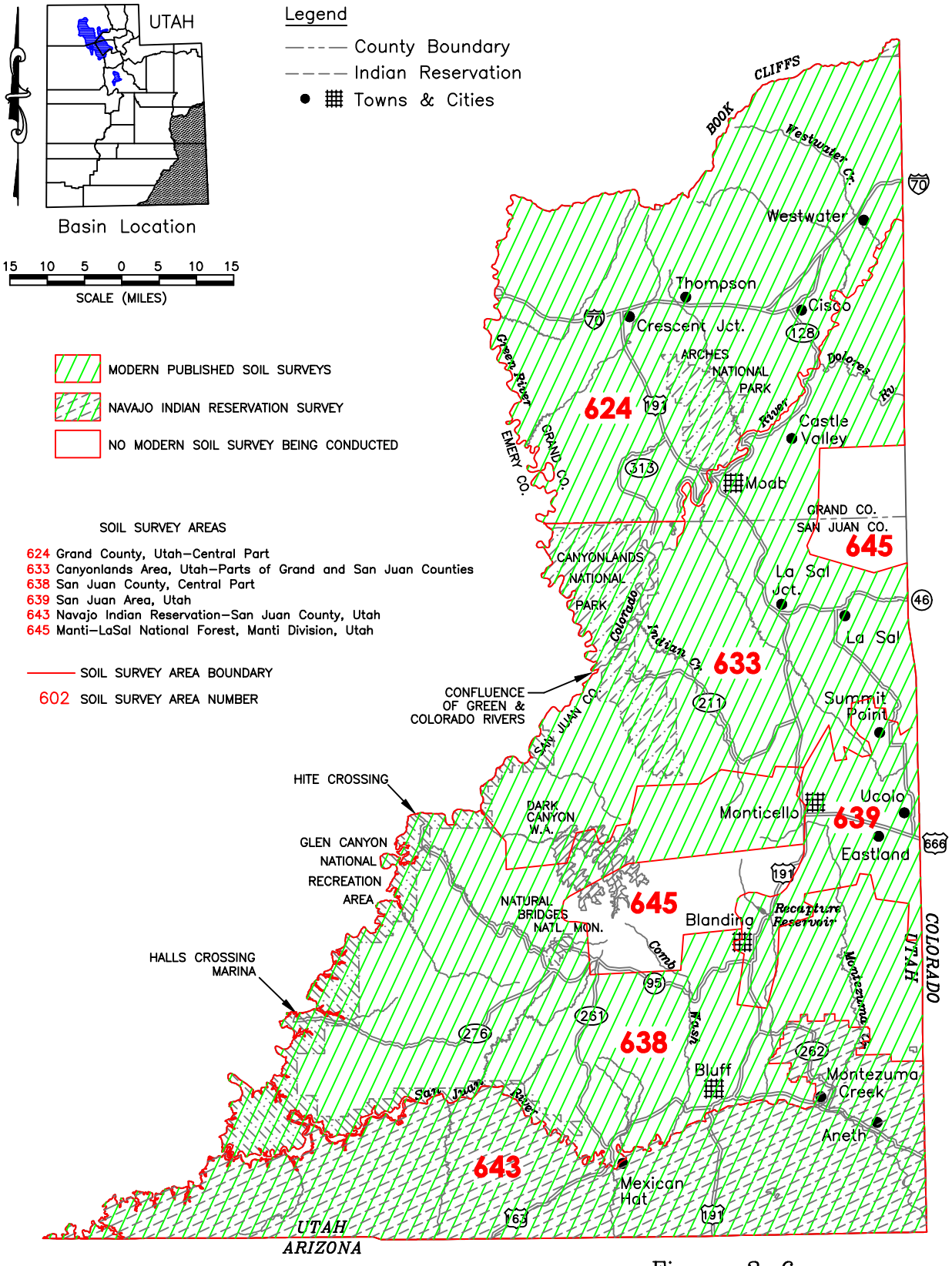


Figure 3–6
SOIL SURVEY AREAS
Southeast Colorado River Basin

Source: Natural Resources Conservation Service
Revised June 1996 1000210

Table 3-2
SNOTEL AND SNOW COURSE DATA
1961-90 Average

Station	Elevation (feet)	April 1st SWE[a] (inches)	Annual Precipitation (inches)
SNOTEL			
Camp Jackson	8,600	9.8 (10.4)[b]	28.6
La Sal Mountain	9,400	11.9 (12.6)[b]	30.5
SNOW COURSE			
Buckboard Flat	9,000	12.6	31.6
La Sal Mt Lower	8,800	9.7	No gage

[a] Snow water equivalent in inches.
[b] Average March 1st readings.
Source: Utah Cooperative Snow Survey Data, NRCS. [73]

rangeland may be limited because of steep slopes. Wildlife includes deer, elk, black bear, coyote, mountain lion, bobcat, small mammals, raptors, sage grouse and some aquatic species.

The **Mountain Climatic Zone and Mountain Brush Type** are at elevations of 7,800 to 8,900 feet and the annual precipitation is 16 to 25 inches. Soils are shallow to deep, well drained and are found on benches and mountainsides. The vegetation is primarily trees, shrubs and grasses including Utah juniper, pinyon pine, some Douglas fir, Gambel oak, big sagebrush, Oregon-grape, mountainmahogany, snowberry, needleandthread and bluegrass. Wildlife include elk, deer, black bear, coyote, mountain lion, bobcat, small mammals and raptors. There is some aquatic habitat. This zone is used extensively for rangeland although in some areas, use is limited because of steep slopes.

The **Upland Climatic Zone and Pinyon-Juniper Forest Type** are at elevations of 6,000 to 7,800 feet and receive 12 to 16 inches of precipitation per year. The soils are dry most of the growing season but are moist in some parts during the spring and late summer in most years. This zone includes many mesas and higher structural benches. There is livestock grazing, dryland agriculture and small areas of irrigated lands in this zone. The vegetation is Utah juniper-pinyon stands, big sagebrush, mountainmahogany, Basin big sagebrush, birchleaf, Salina wildrye, Western wheatgrass and Indian ricegrass. Wildlife include deer, bobcat, foxes, small mammals and raptors.

The **Semidesert Climatic Zone and Sagebrush Type** are at elevations of 3,700 to 6,100 feet and receive 5 to 8 inches of precipitation annually. The soils are semidesert loam, sandy loam, and stony and gravelly loam. They are dry most of the growing season except during spring and early summer. The vegetation is mainly shadscale, blackbrush and big sagebrush with areas of Utah juniper and pinyon at elevations above 5,000 feet. Sagebrush is found in this zone and also at nearly every elevation and range of precipitation on deep, well-drained soils in every other climatic zone and vegetation types. Wildlife includes deer, coyote, badger, foxes, small mammals and

raptors. This zone contains dry cropland and irrigated cropland.

The **Desert Climatic Zone and Grass and Desert Shrub Type** are at an elevation of 3,500 to 6,100 feet and receive 5 to 8 inches of precipitation annually. Vegetation is mostly shadscale and blackbrush with some big sagebrush although there is fourwing saltbush on the deeper sandy soils. Indian ricegrass and needleandthread are most dominant of the grasses. Soils vary from loam to sand to clay. Wildlife includes mountain lion, antelope, deer, coyote, bobcat, foxes, white-tailed prairie dog, cottontail and black-tailed jack rabbits, song birds and raptors. Big horn sheep are found in the Red Canyon-Colorado River area. This zone contains irrigated cropland.

Land Use - Soil is generally used to provide the highest production or for the best use according to its capability. The Natural Resources Conservation Service has established capability groupings to show the soil suitability, limitations and expected response to various types of treatment.

Capability classes, the broadest group, are classified on a numerical scale from one to eight indicating progressively greater limitations and narrower choices for agricultural cultivation. Other uses, such as grazing for livestock or wildlife, may not be as restrictive. The lower class numbers are choice lands suitable for growing irrigated and dryland crops. The higher class numbers are more suitable for permanent pasture and progressively to grasslands, forested areas and rocklands.

Lands used for farming can also be defined according to their agricultural production ability and potential. Two categories describe the better croplands: prime farmlands and farmland of statewide importance. There are over 61,000 acres of prime farmlands.

There are about 8,930 acres of irrigated cropland with an additional 4,400 acres of idle/fallow land and 130,400 acres of dry cropland. Urban, residential and other intensive land uses are usually located in these same areas. Less intensively developed areas surround the farmlands. Over 37 percent of the basin or about 2.36 million acres are used for grazing by livestock and wildlife. Timber production, mining and other purposes are also important uses. In addition, much of the area is covered by bare rock. The less intensively developed areas are also used for a wide variety of recreational pursuits including rock hounding, sightseeing, hiking, hunting and ATV activities.

Wet and open-water areas are an important environmental land use. These areas include marshlands, lakes, reservoirs, rivers, sewage lagoons, riparian lands and industrial evaporation ponds. Wet and open-water areas consume significant amounts of water by either surface evaporation or evapotranspiration of natural occurring vegetation. Wet and open-water areas are generally located within municipalities, along existing river systems or in areas with relatively high water tables. There are over 100,600 acres of wet and open-water areas within the cropland areas.

3.3.4 Land Status

The total area of the Southeast Colorado River Basin is 6,976,250 acres (10,900 square miles). Of this total, 66.9 percent is administered by various federal agencies and 18.2 percent is included in Indian reservations/lands. The state of Utah administers 7.4 percent leaving 7.3 percent of the area as private land. There are 10,520 acres of water. The distribution of these areas is shown in Table 3-3.

The federal land managing agencies include the Bureau of Indian Affairs, Bureau of Land Management, Forest Service, National Park Service and Department of Defense. Indian reservation lands are controlled by three tribes;

Table 3-3
SUMMARY OF LAND OWNERSHIP AND ADMINISTRATION

Land Status	County		Basin Total	
	Grand (acres)	San Juan (acres)	Area (acres)	Area (percent)
Federal				
Forest Service	57,600	403,340	460,940	6.6
Bureau of Land Management	1,488,340	2,053,460	3,541,800	50.8
National Park Service	75,720	519,380	595,100	8.5
Wilderness Area	0	68,030	68,030	1.0
Department of Defense	1,630	0	1,630	neg.
Indian Reservations/lands	870	1,269,790	1,270,660	18.2
Federal Total	**1,624,160**	**4,314,000**	**5,938,160**	**85.1**
State	256,040	262,630	518,670	7.4
Private	95,670	413,230	508,900	7.3
Water Areas [a]	150	10,370	10,520	0.2
Basin Total	**1,976,020**	**5,000,230**	**6,976,250**	**100.0**

[a] Water areas are under various ownerships.

the Navajo Nation, the Ute Mountain Ute Tribe and the Northern Ute Tribe. State agencies include the School and Institutional Trust Lands Administration; Division of Forestry, Fire and State Lands; and the Division of Parks and Recreation. Significant issues include water development, water quality, timber production, range management, recreation development, and mineral and petroleum exploration and extraction.

All of the area was originally public land. When Utah gained statehood, four sections in every township were designated as state lands. The state could not claim title to these lands until after they had been surveyed, some within the last 3-4 decades.

Other land withdrawals have taken place also. Land was withdrawn for a national forest preserve in the La Sal area in 1906 followed by one in the Monticello area in 1907. The La Sal and Monticello preserves were combined in 1988 as part of the Manti-La Sal National Forest. The Utah park system includes Dead Horse Point (1959), Edge of the Cedars State Park and Museum (1978), Goosenecks of the San Juan (1962) and Newspaper Rock (1961). The national park system includes Arches National Park (1971), Canyonlands National Park and Recreation Area (1964), Hovenweep National Monument (1923), Natural Bridges National Monument (1908) and Rainbow Bridge National Monument (1910).[42] See Section 15, for more information on these areas.

3.4 WATER RELATED HISTORY[45,46,50,87,88,89,95]

The Southeast Colorado River Basin has a long and rich history relating to the development and use of its water resources. It seems not everyone knew this, as the Deseret Evening News once called the area a "vast contiguity of waste" whose main function was "to hold the world together." Many have imagined this area as unproductive and uninhabited. It has never been either one.

At the end of the last great Ice Age, the ancient Paleo-Indians roamed most of North America from about 11,500 to 8,000 years ago. They hunted large animals such as mammoths and large bison and gathered wild plants. With warmer weather emerging, the Archaic peoples moved toward the southwestern deserts. Here they hunted smaller animals such as deer and bighorn sheep and became more dependent on wild plant food for survival in this more arid area. With the adoption of a maize or corn horticulture by about 1000 B.C., the Archaic people started using cultivated plants. This was about the time the Anasazi culture became evident, first the Basketmakers and later the Pueblo groups. They began diverting small streams of water to irrigate their crops which consisted primarily of corn, squash and later, beans. They still followed the hunter-gatherer tradition, returning to tend and harvest their crops.

Anasazi ruins

Recent insights into Anasazi Indian life have resulted in some unexpected data on agricultural practices and particularly on some irrigation methods.[40] A series of stone-lined ditches and agricultural terraces have been found in southeastern Utah. These land-conserving terraces were used to raise crops with water diverted from channels. At Beaver Creek on the Rainbow Plateau, an entire ditch and field complex has been discovered. Here, water was diverted at the upper edge of an alluvial fan and conveyed in stone-lined ditches to a terrace system where successful gardening was carried out. It was estimated this system supported a community of over 20 households.

There is also evidence in other areas of masonry retaining walls built on bare Kayenta formation ledges along a stream. Some earth is still retained behind the walls and was still moist from seepage from the Kayenta-Navajo contact. It appears the soil had been placed when the terrace was built. Soil-conserving and crop producing terraces such as these are common on the slopes of Navajo Mountain.

There is still speculation about the disappearance of the Anasazi culture from the area. Evidence points to two possibilities, a prolonged and severe drought or they were forced to leave to avoid more aggressive cultures. In any event, after the agriculturalist Indians disappeared, the nomadic Utes and Navajos used the area as their hunting grounds. There is also evidence the Southern Paiutes moved into the area from the west. One thing is sure, the local Indian inhabitants changed several times over the years as one tribe would challenge another and lay claim to the region. However, the basic method of water use remained relatively unchanged.

The area was to become part of the Old Spanish Trail, established during the late 1700s and early 1800s. One segment entered Utah following the Colorado River to near Cisco where it turned and went west, crossing the Green River near the town of the same name. Another alternate entered Utah south of the La Sal Mountains in the Lisbon Valley area. From here it went northwesterly around the northwestern flanks of the La Sal Mountains,

Settling the land

down Spanish Valley and crossed the Colorado River near Moab and then north to the Green River crossing. Although the only water needed was for survival, the Old Spanish Trail was a part of the area history.

From the mid- to late 1800s, the Mormon influence on development of the area's land and water resources was established. To meet their immediate need for food and to develop a stable economy, Mormon immigrants focused on developing irrigated agriculture where readily accessible water existed, first at the Elk Mountain Mission in 1855, along the San Juan River in the 1880s and eventually throughout the area.

The earliest attempt to settle the land was the Elk Mountain Mission in 1855.[45,87] The Indians were already irrigating about 10 acres, having planted seeds provided by the advance party the year before. The settlers diverted water for vineyards, orchards and vegetable crops using earth and brush dams. The settlement was abandoned that fall after attacks by the Ute Indians. Later in the 1880s after the settlers were reestablished, they built a more substantial log diversion on Mill Creek above Spanish Valley. Water was also diverted from springs for culinary use and for irrigation. Eventually, water was diverted from both Mill Creek and Pack Creek to irrigate lands in Spanish Valley.

Homesteaders came to San Juan County in 1878 and located on Deer Creek, about one mile southwest of present Old La Sal where they tended their milk cows and made butter and cheese. About two months later, other settlers brought in about 2,000 head of cattle and located at Coyote, about one mile west of the present La Sal Post Office. This was the first large cattle herd in San Juan County. It was 1895 before the first canal was constructed to bring water from La Sal Creek to Coyote Flats. A large area was soon fenced and planted to alfalfa and grain along with some fruit trees and a grove of poplars.

When the "Hole in the Rock" expedition arrived in Bluff in the spring of 1880, they were weary from their journey so the main body decided to settle there instead of at Montezuma Creek as originally planned. The settlers in Bluff constructed a diversion using riprap to divert water from the San Juan River. Because of the high sediment load in the river, it took back-breaking hand-shovel work to keep the silt and sand out of the ditches so the water could make it to the fields. This system was not very stable and problems soon developed. Keeping the Bluff system in operation was a constant, almost daily demand on the settlement. Years later it was said of Bluff that the acreage was small, the river treacherous, and the water supply uncertain.

Shortly after the settlement of Bluff, part of the expedition moved on to Montezuma Creek. They soon had a waterwheel, 16 feet in diameter and 12 feet across, delivering about 40 gallons per minute for irrigation of nearby lands.[46] Soon there were three additional waterwheels in operation. They were better off than Bluff because they had rock shelves to anchor the waterwheels, while the downstream diversion had to rely on riprap dams and hand-shovel work. There was also a small irrigation system in Aneth that had been established the year before.

This new prosperity was to be short-lived. Floods in the San Juan River in 1884 wiped out the entire community along with the waterwheels at Montezuma Creek except for one home built on a high rock outcrop. The people in Bluff fared better as the flood plain was wider in this area. Still, the floods from the

San Juan River and Cottonwood Wash covered many of the homes, corrals and cropland with 8 to 10 inches of mud, destroyed part of the riprap dams and silted in parts of the canal.

Settlers from Bluff moved into Verdure (South Montezuma) in 1887 while they were locating and getting ready to settle Monticello (North Montezuma). They worked diverting water from North Creek although the Carlisle Cattle Company already claimed the stream. After their differences were settled, they formed what is now the Blue Mountain Irrigation Company, the oldest in San Juan County that is still in existence.

Because of the effort needed to establish Monticello, White Mesa remained a luscious grazing area until the establishment of San Juan County's youngest town, Blanding in 1897. They soon started surveying and construction began on a ditch to divert water from Johnson Creek onto the mesa. The surveying was done with a carpenter's level and a board about 18 feet long. As they surveyed and built the ditch, they came to about 100 yards of solid rock. They worked from both ends and soon had a tunnel. Because an illusion distorted what was uphill and downhill, the LC Ranch cowboys would pass and laugh about the crazy men trying to make water run uphill. After several interruptions, the project was finally completed in the spring of 1903.

As the population of Blanding started to grow, it appeared the demand for water was going to exceed the supply of Johnson and Recapture creeks. The White Mesa Irrigation Company decided in 1921 to build a tunnel to divert water from Indian Creek on the northern flank of the Abajo Mountains to Johnson Creek on the southern flank. This mile-long tunnel was to be the longest ongoing project (over 30 years) in the area. After tremendous personal sacrifice and a lot of faith, a few individuals kept the project going until in June 1952, water was delivered to the fields in the Blanding area.[103]

During these same early years, the area was discovered by large ranchers from southwestern Colorado and northern Texas. The L.C. Company established itself in about 1880 at the confluence of Recapture and Johnson creeks. They ran about 17,000 cattle. The Carlisle Company established a headquarters at Paiute Spring in 1883. They were soon shipping over 10,000 head to market. Soon the area was being grazed by thousands of cattle owned by several large companies. They were all attracted by the excellent rangeland and by the low taxes. There was also the advantage of abundant winter range along with nearby summer range on the La Sal, Blue and Elk mountains. But by the late 1890s, most of the large operators had sold their land and cattle. Problems with Indians, rustlers and low cattle prices all contributed to the demise of the cattle industry. However, the main reason was the deterioration of the range due to severe overgrazing along with the worst drought in history.[102]

Indian Creek tunnel

Evidence of the changing weather patterns can be gleaned from several sources. When the settlers first moved into San Juan County, it was toward the end of an unusually wet period. This was evidenced by the fact the Hole-in-the-Rock settlers of 1879 were only able to work on the road when drier weather permitted. The San Juan River was always running high. Beginning with the spring of 1886, storms were very light and drought soon covered the area. After over a decade, the storms came again and by 1897, the drought was over, just after the large cattle herds had gone.

The economy soon started to improve as water was developed for irrigation. The

rangeland started a slow recovery but will never, nor should it, sustain the large herds of the past. The discovery of oil, uranium and several other minerals also contributed and helped accelerate population growth and increased demands for the basic necessities of life.

Valley City is an example of a once thriving farming community which is now a ghost town. In 1905, work began on a reservoir to store water for the irrigation of 2,500 acres of land in an area about five miles south of Crescent Junction. There were soon 60 acres of orchards under irrigation. A few years later, the dam was washed out by a flash flood. The dam was rebuilt but the community never recovered. Shortly after 1930, the school was closed as people left and Valley City became a ghost town.

Until the late 1950s, local water demand for most domestic uses was adequately met by surface water and groundwater sources. Culinary water systems had been constructed in Monticello and Blanding by the turn of the century and in Moab shortly after. Bluff drilled wells to tap the groundwater in the San Juan River flood plain. However, the steady increase in population required the construction of various projects to develop supplemental water supplies. The largest of these ventures resulted in the construction of the Mill Creek, Monticello and Recapture Creek reservoir projects and a culinary well field near Moab. Early attempts at developing the area's water supplies were financed by a combination of direct contributions from local businesses or from tax revenues. ❑